ECONOMIC FACTORS IN THE GROWTH OF THE OILSEED INDUSTRY IN THE UNITED STATES

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ALLEN B. PAUL

B. S., University of Illinois, 1940

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AN ABSTRACT OF A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
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ECONOMIC FACTORS IN THE GROWTH OF THE OILSEED INDUSTRY IN THE UNITED STATES*

THIS study inquires into the nature and causes of the growth of the oilseed industry in the United States and gives some attention to the consequences of and prospects for the industry. The analysis is divided into a study of (1) factors affecting the supplies of, utilization of, and demand for the commodities considered and (2) the nature of, reasons for, and significance of the organizational pattern of the processing industry. The major sources of information came from publications of federal and state agencies, trade and financial publications, and general economic literature.

Supply Factors

Characteristically all production trends exhibit a rapid growth in the early years, and a gradual retardation of the growth rate. Among the oilseeds, maturation is now shown by cottonseed, flaxseed and corn germs; vigorous growth, by soybeans. Causes for such behavior may be traced to the impact of dynamic factors (population, technology, tastes, foreign trade, and social policy) on the supplies of and markets for the commodities in question.

* An abstract of a doctorial thesis presented at the University of Illinois.

1. Cottonseed and related products—the supply of an oilseed produced as the minor product of a joint output depends largely on the output of the major product. The cotton crop was about six times more valuable than the cottonseed crop in the past 35 years,

In the past century and one-half the expansion of cotton produtions was due to availability of new land, abundant labor supplies, improved transportation, improved techniques of producing cotton and the expansion of foreign and domestic markets for cotton. The gradual retardation of growth of cotton production was based on the increased foreign production of cotton, production of substitute fibers, slackening of the domestic population growth rate, the limited reserve of new lands, and restrictive social policy. However, ameliorating factors have tended to impede the decline (e.g. improvements in yields, increased domestic per capita consumption of cotton). The peak of U. S. cotton production was reached in the 1920's and there appears to be no bright prospect for reversing the decadent tendency in the future.

The cotton seed crushing industry began in the 1850's but experienced its important growth between 1870 and 1910. Factors in its growth (other than the availability of cottonseed) were the development of processing techniques, transportation and markets for cottonseed products. After 1910, the percentage of cottonseed crop (not used for seed) crushed, averaged 88 per cent and varied from year to year directly with real prices received for cottonseed and inversely with real cash incomes from cotton. In the main, the supply response was inelastic and little significance can be attached to prices or incomes in explaining the annual variations in supplies of cottonseed. The development of appropriate solvent extractor systems could increase the annual cottonseed oil supply as much as 15 percent. Future increases in cottonseed oil production are more likely to come through this avenue than through others, but the change probably will be slow.

Imports of cottonseed or cottonseed products have been minor factors in the total domestic supplies. Cottonseed is not an international commodity in the usual sense and production of cottonseed products has been a backward industry in most cotton producing countries.

2. Corn germs—Corn oil is produced mainly as a minor product of the corn refining industry as well as in the corn alcohol and corn

milling industries. The corn refining industry grew into maturity in the past half century and further expansion of the output of corn oil is mainly contingent upon its rejuvenation through the discovery of a larger market for starch or glucose products.

3. Soybeans and related products—Soybeans are relatively new as a grain crop, important acreage expansion occurring in the 1930's. The highest per acre yields are obtained in the Corn Belt where production is most concentrated. Analysis of crop acreage changes since 1925 in Illinois, Iowa, Indiana, and Ohio by crop reporting districts (80 percent of U. S. soybean production) indicates that soybeans tended to displace all major uses for tillable land rather than any selected crop(s). However, in the recent 1940–44 period corn and soybeans were most directly substitutable. The soybean-corn acreage ratios varied inversely, and significantly with the corn-soybean yield ratios. Oats and wheat were not significantly associated with soybeans in this respect. In earlier periods, small grains and soybeans may have competed more closely.

An analysis of both gross and net returns per acre from soybeans and other major crops from 1930 to 1944 indicates that soybeans were more profitable than small grains, but less profitable than corn, except perhaps in the 1930–34 period. However, complementary and supplementary relationships between different crops tend to obscure the relative advantage of growing one crop in place of another when comparisons are made without regard to these interrelationships. The soybean crop has several such interrelationships with other crops.

The important factors underlying the growth of soybean production were: A relatively greater improvement in per acre yields of soybeans than in yields of alternative crops, prior to 1940–44; the drouth and disease resistance of soybeans; a relatively greater reduction in costs of producing soybeans than of corn, since 1932; and the governmental production adjustment programs, particularly those of 1934, 1935, 1939, 1940, and 1941. Probably the acreage of soybeans would have expanded had there been no drouth or governmental programs, but the latter factors were important. The parity payment feature of the 1939–41 programs was a more important factor in reducing corn acreage than was the financial attractiveness of soybeans.

Although the future of soybean production is difficult to predict, soybeans have established themselves as an important commercial

crop. Quite apart from the future level of soybean production, the areas are likely to shift in importance. Production may increase in the flat clay-pan areas of Illinois, Indiana, and Missouri if general soil improvement practices are followed. Much idle land there may be brought into cultivation. On the other hand, improved corn yields in the commercial each corn area (due to improvements in soil management) will reduce the acreage in soybeans.

The soybean processing industry developed more rapidly than the cottonseed processing industry, and the more efficient solvent process is replacing mechanical methods. About 15 percent more soybean oil could be secured from the annual crush if the solvent process were universally adopted.

4. Flaxseed and other oilseeds—The production of flaxseed in the United States has begun to change only in recent years from a pioneer sod-land crop to a well-established crop in settled areas. Accompanying this trend, the production areas have shifted back eastward. Only since 1939 have per acre yields become relatively stable, reflecting, in part, adoption of wilt-resistant varieties, better cultural practices, and selection of more suitable areas. On this basis it may be assumed that the production of flaxseed in the United States will increase in future years. However, only limited regions can grow the crop successfully, and flaxseed will probably remain in deficit supply. Imports will probably continue to balance requirements for linseed oil for drying purposes.

The copra and palm tree industries of the East Indies developed rapidly since World War I. The United States has imported large quantities of these oil products for use in soap and various foods until the 1930's after which the imposition of certain taxes somewhat limited imports. Both industries are relatively young and new areas and improved techniques of production will probably contribute toward greatly increased supplies in the future, even at low prices. The long production period and use of native labor permit high output at prices that just cover the relatively flexible variable costs. Hence, the oils will compete strongly with domestically produced fats and oils. However, the need for improved transportation, etc. will impede the rapid expansion of exports.

The babassu industry in Brazil is similar to, but younger than, the copra and palm industries in the East Indies. The potential production apparently is large; however, technical difficulties may hold down the industry for a long time. As yet the United States

has not placed import duties or excise taxes on either the imported babassu oilseed or oil.

The peanut and olive in the United States are used as food rather than crushed for oil. Although both are protected with relatively high duties, the prices of peanut and olive oil are not attractive enough to induce a large domestic supply.

Castor beans, tung nuts, and sunflowers have been minor oilseeds in the United States. The castor bean has usually been imported more cheaply than it can be produced domestically, although certain technological advances in the future and/or tariff changes could alter this somewhat. Domestic production of tung nuts is limited by exacting requirements of the tung tree and the high labor requirements in harvesting. Presumably, production could increase when and if the crop shifts from large scale commercial production to small family farms in the narrow southern belt in which the crop is adapted. The sunflower is used for forage and feed in the few states where it is grown extensively. Difficulties with yields and harvesting would have to be overcome to make the crop profitable for oil purposes.

Such oilseeds as are obtained from the sour cherry canning industry, the dried fruit industries, and the fruit juice industries are interesting rather than significant in the total supply of oilseeds. The particular problem in these industries is to secure sufficient volume to make crushing profitable.

The tropical tree crops have a competitive advantage in production over annually produced oilseed crops, except those which are minor products of joint outputs.

Utilization and Demand Factors

1. Vegetable oils—The U. S. per capita domestic disappearance of all fats and oils increased 17 percent from 1920–24 to 1935–39. In 1940, about 40 percent of the fats consumed were of vegetable origin. Food soap, and drying oil products were the principal uses. Invisible fats (in milk, eggs, meat, etc.) make up nearly one-half of the total food fats consumed in normal periods. In 1917–18 and 1944–45, the consumption of invisible fats increased, replacing the decreased consumption of visible fats. Thus there is competition between the two forms of fat for a place in the diet, but no trend is discernible in their relative importance.

Among the visible fats, the per capita consumption of vegetable oil products increased most. Consumption of pork fat cuts and

butter did not increase. The quantity and quality of fats consumed are directly related to family income. Low income groups consume less fat than medium and high income groups. Higher income groups may eat no more fats than medium income groups, but they consume more expensive forms of fats (e.g. butter, shortening, salad oils, salad dressings, etc.). The lower income families consume more lard and margarine.

Shortening, which developed historically as a substitute for lard, has become a distinctive product in its own right, and ways are being sought to give shortening-like properties to lard. However, production of shortening is still adjusted to the quantity of lard available for sale in the domestic market. Therefore, total lard production and exports are extremely important to the consumption of shortening. Although there is no evidence that the demand for shortening agents (lard plus shortening) increased in the 1912–41 period, there is evidence that the demand for shortening by itself increased. Accompanying an increased demand for shortening there was a marked decrease in substitution of the two products (as indicated by the decreasing elasticities of substitution). Product improvement and sales efforts were causal factors. Soybean oil has replaced cottonseed oil as the major ingredient in shortening despite its tendency to flavor reversion. This reflects the relatively inadequate supplies of cottonseed oil, on the one hand, and possible improvements in soybean oil as an ingredient, on the other hand.

Margarine competes with and adjusts itself to changes in butter consumption. The future of margarine depends on this and on technical improvements in the margarine product, educational campaigns, and the character of discriminatory legislation. There is no evidence that the demand for margarine has increased over the 1910–41 period; prices declined sharply and consumption increased more gradually. Since 1934, cottonseed oil and soybean oil have become the important ingredients replacing coconut oil. The shift from coconut oil reflects the effect of restrictive taxes on use of imported oils and of technical improvements in the use of domestic oils in margarine.

Salad dressings doubled in output from 1931 to 1941. Consumption appears to be related to increasing consumption of green and yellow vegetables. The very high grade edible oils (e.g. cottonseed, corn, sesame, etc.) were usually used.

The per capita production of soap has been increasing. There is some evidence of an increased demand for soap, 1925–39, reflecting

increased incomes, a trend toward cleanliness, use of home washing machines, and sales efforts. The imported lauric acid oils have a technical advantage as ingredients. The upward trend in soap consumption will probably continue.

The consumption of drying oils is intimately related to changes in industrial production and construction. There is evidence that the secular demand for drying oils remained constant, 1912–41. Although tung, perilla, and linseed oils are the naturally superior drying oils, recent technical advances will place castor oil and soybean oil in a somewhat stronger competitive position.

2. Oilmeals—Nearly all the vegetable oilmeals are used in the domestic feeding of livestock. Minor amounts were used for food, industrial products or processes and for exports. The oilmeals are valued by feeders principally for their high-protein content. Competing closely with the oilmeals are the animal proteins, millfeeds, and brewers' and distillers' dried grains. However, the bulk of the protein fed to livestock comes from pasture, hay, silage, stover, and grains. Small changes in quality and quantity of the roughages and grains can cause profound changes in the amount of high-protein concentrates required.

There was a marked upward trend in the quantity of commercial high-protein feeds fed per unit of livestock, 1926–27 to 1944–45; but more proteins are still needed to balance livestock rations. Increased nutritional knowledge, increased livestock numbers, and educational efforts of governmental agencies and the feed industry have been important factors underlying the trend.

The major change in the demand for feeds, apparently, has been the increased demand for soybean oilmeal. This was a factor contributing to the rise of the soybean industry. The prospect for increasing the demand for the oilmeals depends upon the total demand for proteins and upon the supply from alternative sources.

The increase in soybean meal since 1934 has been spectacular. Most of the increase in high-protein feeds has been in soybean meal. This has helped to fill a gap in animal feeding requirements and has been an important factor in the expansion of animal feedstuffs that occurred during the war. If demands for the oilseed meals increase, it appears that soybean meal production is likely to increase more than the other oilseed meals to meet these demands.

Organization of the Processing Industry

1. *Plants.* The oilseed processing industry may be divided into

fourteen census industries on the basis of the major products produced. These industries have the common characteristic of utilizing large quantities of oilseeds, vegetable oils or oilmeals in their processes. They represent the several segments of the oilseed industry adequately for present purposes even though they did not produce the entire output of their major products, nor confine themselves to the manufacture of the main product.

Like most manufacturing industries, size of plants varied widely in the several industries studied. These variations are due to (1) the different grades of resources available to the individual plant (2) the strategic decisions in fitting the plant into an integrated firm's production scheme and (3) lagging adjustments to changing conditions. That there was more concentration within some industries than others is due to the specific economic conditions in each industry.

Processing margins tended to decrease with increased plant size except in certain industries where monopolistic elements may be quite marked.

Comparison between principal plants in different segments of the oilseed industry showed them to vary in size, degree of mechanization, annual wages paid and processing margins. These variations have rational explanations. For example, the processing margins of the manufacture of industrial oil products (soap, paint, linoleum, printing ink, artificial leather and oilcloth) were roughly twice as large as the margins of the crushers, manufacturers of edible oil products (except margarine), or mixed feeds. The economic explanation is mainly in terms of production costs, partly in terms of monopolistic elements.

2. *Firms.* Most of the important plants in the industry belong to multiplant firms. A small number of firms in each segment of the industry, with few exceptions, produced over one-half of the output of their segment. This concentration is characteristic of all manufacturing industries in the United States. However, in at least seven of the fourteen segments the concentration has lessened during recent decades. The relative concentration among these industries may be explained by a set of economic forces operating through materials, processes, products, or markets.

Vertical integration was the least important type of integration in the industry. Only 10 percent of the crushers' products were reported as inter-plant transfers in 1939, even though 30 percent of the plants reported such transfers. The complex interrelationships

among processes make it difficult to integrate precisely. Horizontal integration was prevalent throughout the industry, particularly in the industries having relatively small, widely scattered plants. Partial integration (based on similarities in materials, processes, or markets) was a common characteristic of multiple product businesses, e.g. soap-shortening, flaxseed-soybeans, paint-printing ink, etc. The type and degree of integration present in each of the oilseed industries have an economic explanation based on the logical avenue for expansion available to the individual firm.

There was no evidence as to whether large, medium, or small businesses in the industry were most efficient. In individual cases, efficiency would appear to be as much a function of management as of size, and comparisons between firms within an industry are impaired by the differences in the product make-up of their businesses.

The prerequisite for monopolistic behavior existed in some segments of the industry—a small number of buyers or sellers (resulting from industrial concentration, product differentiation, or collusion). However, the degree to which a raw material has alternative uses, or a manufactured product meets good substitutes, limits the area in which monopolistic control can be made effective. For example, the highly concentrated corn refining industry can exert relatively little effect over the price of the corn it purchases (since most corn is used elsewhere) nor can it set prices of starches, sugars, syrups, or oil very freely in view of the many substitutes available for these products. On the other hand, conditions in the linseed crushing industry permit more control over the prices paid for flaxseed and the prices obtained for linseed oil. What degree of control is actually exercised in the latter industry is undetermined. In these and in other industries, the elasticities of the supply and demand curves are more significant facts in analyzing monopolistic possibilities than is the condition of small numbers. The competitive elements in the oilseed industry appear, by and large, to be more important than the monopolistic elements and any detailed appraisal of monopolistic behavior within the industry should also inquire into cost conditions and the permanence of monopolistic situations before judgments are rendered.

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Allen B. Paul was born in Gunnison, Utah, on December 30, 1917. He attended grammar school in Chicago and high school in Palatine, Illinois, where he graduated in 1935. In the 1935-36 school year he was enrolled at the Central Y. M. C. A. College in Chicago, and in 1937-40, he was enrolled at the University of Illinois from which he received a B. S. in Agriculture, February 1940. He worked on the home farm at Palatine, Illinois, during 1936-37, and during the spring and summer of 1940.

He was appointed Scholar in Agricultural Economics at the University of Illinois for the 1940-41 year and received the degree of Master of Science in Agricultural Economics, June 1941. During the 1941-44 period he returned to the farm, and in 1945, served in the U. S. Navy. He resumed his graduate studies as a Fellow in Agricultural Economics at the University of Illinois, 1945-47.

He is a member of Phi Kappa Phi, Sigma Xi, Gamma Sigma Delta, The American Farm Economic Association, and The American Economic Association.